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(54) **Thin film memory**

(57) A static gadolinium cobalt magnetic thin film memory is based on a Hall voltage output versus applied field characteristic of the amorphous gadolinium cobalt film which is square loop in nature. The memory comprises a layer of GdCo on a silicon chip and overlaid by thin film "write" loops 13, 14. The layer of GdCo is in the form of crossed arms 11, 12. To read out the memory, an interrogation pulse is applied to one arm 12 and the Hall voltage output pulse is provided on the other arm of a polarity dependant on the direction of magnetization of the GdCo film.

FIG.3

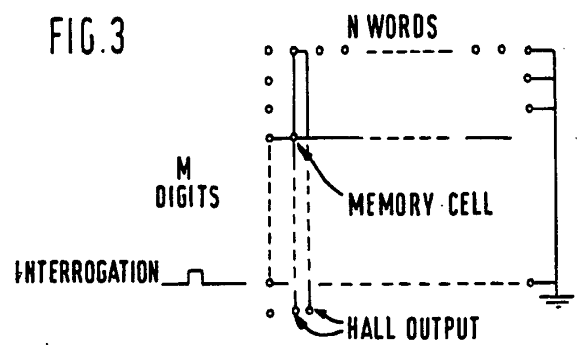

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FIG.1

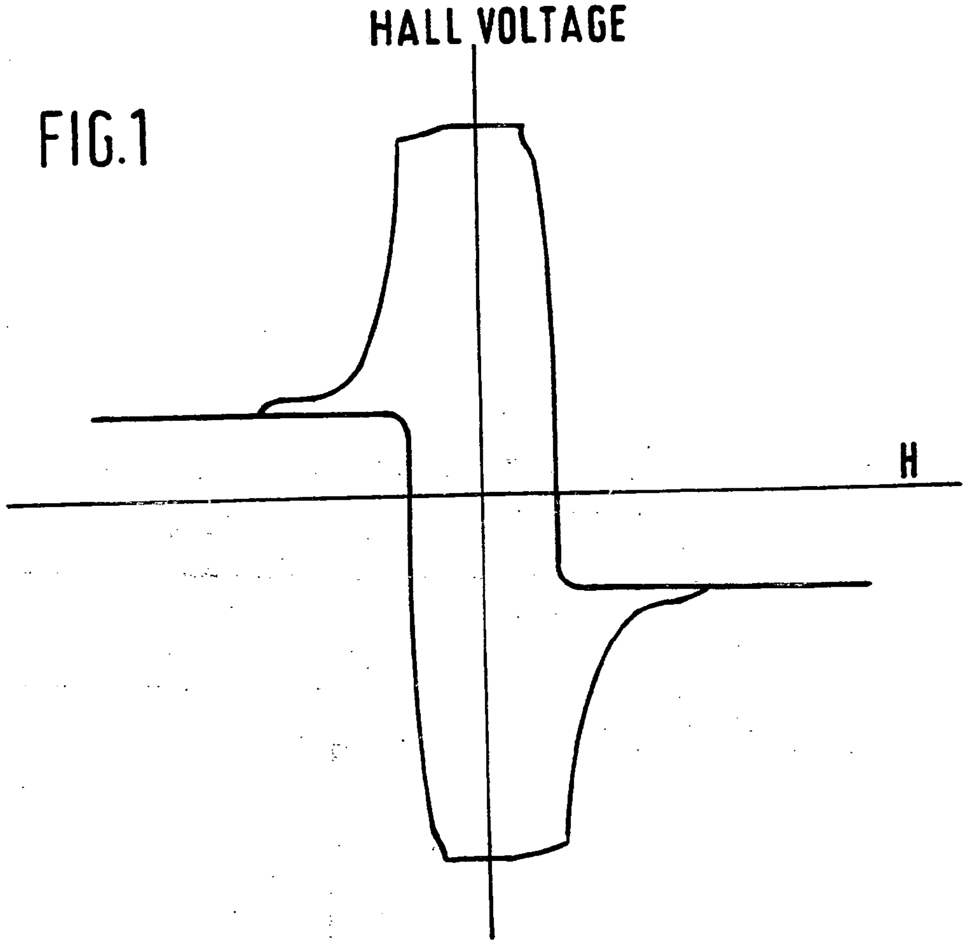
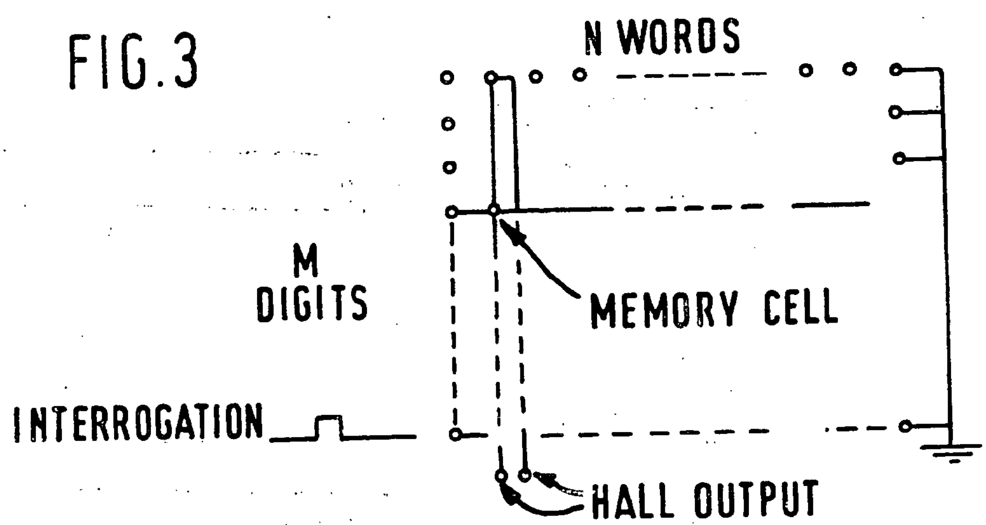

HALL VOLTAGE
H

FIG.3


N WORDS
M
DIGITS
MEMORY CELL
INTERROGATION
HALL OUTPUT

SPECIFICATION

Thin film memory

The invention is in the field of non-volatile, magnetic film memorys.

According to the invention, there is provided a non-volatile magnetic film memory comprising a film of amorphous magnetic gadolinium cobalt on a substrate, said film having energizing terminals and Hall voltage output terminals; and first and second "write" loop conductive films overlaying and in parallel planes with said magnetic film, the coincident energization of said write loops being effective to switch the magnetization direction of said magnetic film.

An embodiment of the invention will now be described by way of example only, with reference to the accompanying drawings, in which:-

Figure 1 shows in graphical form the hysteresis loop of a GdCo film,

Figure 2 is a diagrammatic representation of an embodiment of a memory according to the invention,

Figures 2A and *2B* are cross-ection views of portions of Figure 2,

Figure 3 is a schematic layout of a typical memory array using the memory cells of Figure 2.

Figure 4 shows the waveforms of the memory cell output.

Referring now to the graphical representation of Figure 1, there is shown a plot of Hall voltage output versus the applied magnetic field of a gadolinium cobalt (GdCo) film. This hysteresis loop of GdCo film which is substantially square can be used as a memory element as further described below.

In Figure 2, a multi-layered magnetic thin film memory is shown comprising a substrate 10 (such as silicon) on which is put down a number of layered thin films by conventional film dposition techniques, such as rf sputtering, the first of the films comprises an amorphous gadolinium cobalt magnetic film 11, 12. The gadolinium cobalt film is preferably etched or shaped generally in the form of a cross, the width of one arm 12 being greater than that of arm 11. The GdCo film has overlaying it a pair of "write" loops 13, 14 of conductive films. The "write" loops 13 and 14 are each part circular or the shape of an omega (Ω) with loop 14 rotated 90° with respect to loop 13 but otherwise axially superposed over it. The thin films 11, 12, 13 and 14 have insulative layers 15 between them as is conventional in thin film arts.

Figure 3 shows a typical memory array of the individual memory cells of Figure 2 forming a memory. The Hall output of each memory cell depends on the magnetization of the GdCo film 12 of that cell. This magnetization is determined (set) by the direction and magnitude of the coincident currents in the conductors 13 and 14 of that cell.

Considering the operation of the non-volatile memory, it will be understood that the direction of magnetization of the film 12 can be set and changed by applying coincident pulses in the "write" loops 13 and 14. To read out the memory, an interrogation pulse is applied the length of the broad arm 12 and the Hall voltage output pulse is m asured on the cross arms 11. Thus, as is shown in Figur 4, an interrogation pulse on curve "a" provides an output pulse (curve "b" or "c") of one polarity or the reverse on arm 11, depending on the direction of magnetization of the memory material 12.

The above described memory provides a high speed, high density memory which is size compatible with integrated circuit processing, which is radiation hard and which needs only a low operating power and no stand-by power.

CLAIMS

1. A non-volatile magnetic film memory comprising a film of amorphous magnetic gadolinium cobalt on a substrate, said film having energizing terminals and Hall voltage output terminals; and first and second "write" loop conductive films overlaying and in parallel planes with said magnetic film, the coincident energization of said write loops being effective to switch the magnetization direction of said magnetic film.

2. A non-volatile magnetic thin film memory array comprising a memory array matrix of "m" digits and "n" words and in which each memory array element is provided by the memory of Claim 1.

3. The memory array of Claim 2, wherein the gadolinium cobalt film of each memory is in the shape of crossed arms, and wherein an interrogation circuit is connected to one of the arms, to apply in use an interrogation pulse thereto thereby producing at the other arm a Hall voltage readout of one polarity or the other depending on the direction of magnetization of said film.

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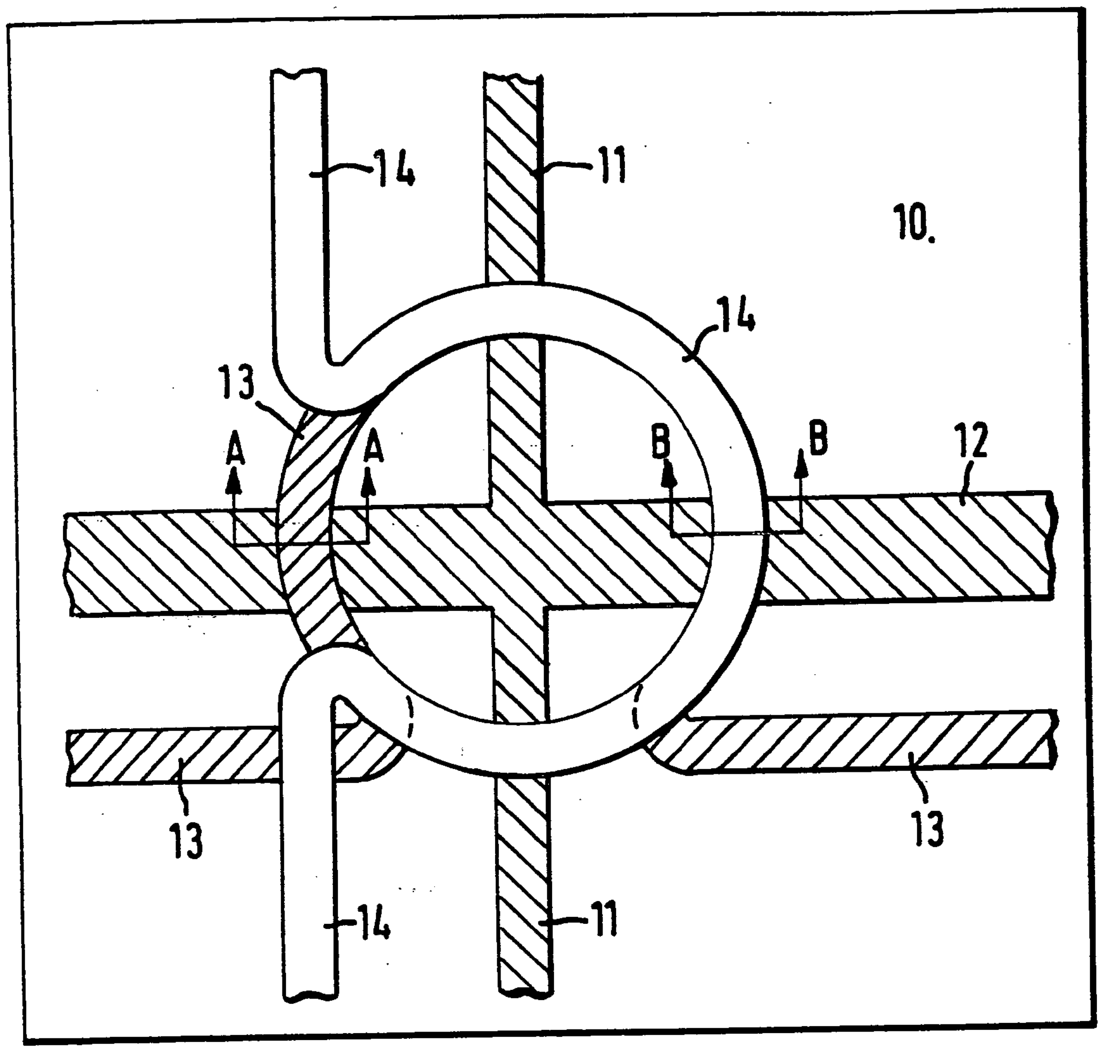

FIG. 2

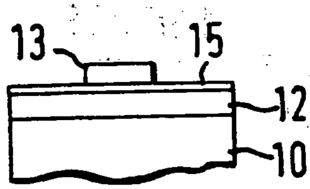

FIG. 2A

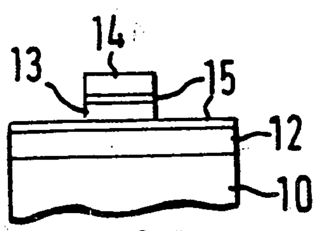

FIG. 2B

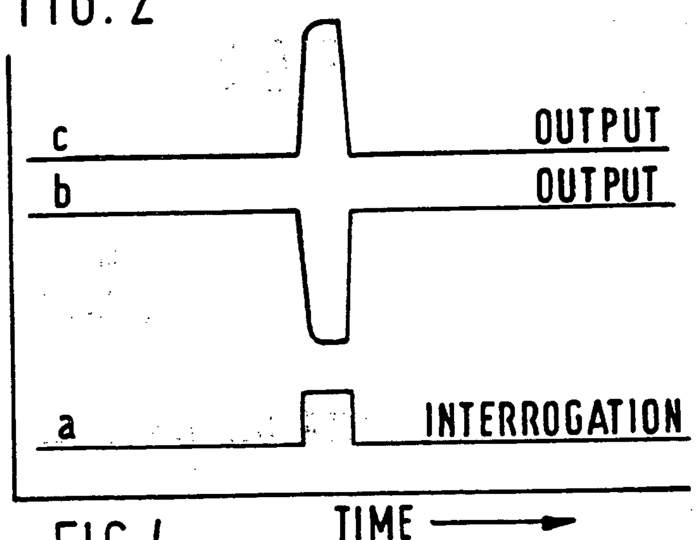

FIG. 4